

of which each series is composed, illustrating each separate division with a synoptic table of its contents and copious remarks on its diagnostic characters. In all these matters their views are of course open to discussion; whether a certain genus does or does not belong to a certain tribe is a matter of opinion, and can only be decided when its anatomical affinities have been thoroughly investigated. But these minutiae are comparatively of small importance, and do not in any way affect the main lines of the system.

Such are the chief features of this great work, extending through 605 royal 8vo pages. The basis on which the system is founded, that of the entire external skeleton, is more consonant with the general scope of systematic arrangement in the higher classes of the animal kingdom, and much less liable to error than the tarsal or any other system which rests upon special organs alone. It is a system which only requires careful study to ensure approval; it has conferred a lasting benefit on science and much honour upon its authors. To assert that it is perfect would be to assert more than man can accomplish. It is at the least a long step in the right direction, and opens a path which must lead to further important results.

But the rôle of Lord Lytton's "Randall Leslie" and "John Burley" will continue to be repeated till the end of time, and plagiarists will doubtless reproduce the views of the American naturalists with some trifling modifications as their own. In the name of common honesty let those who henceforth build upon the lines here laid down have at least sufficient candour to acknowledge their obligations—a candour which recent events have proved to be rare.

XXIII.—*Notes on some Fossil Plants from Northern China.*

By J. S. NEWBERRY*.

MR. ARNOLD HAGUE recently placed in my hands a small collection of fossil plants brought by him from China. They proved to be interesting; and, with his permission, I present briefly the results of my examination of them.

The circumstances under which they were found, so far as known, are given in the subjoined notes of Mr. Hague which accompanied them:—

"This collection of plants came from the coal-basin of the

* From the 'American Journal of Science,' Aug. 1883, pp. 123-127.

Pinhsu-hoo, in the southern peninsula of Mantchuria, on the east side of the Gulf of Liantung, and about one hundred miles north-east of the open port of Niu-chwang. I am told that at times there are over 1200 Chinamen engaged in the district in mining and transporting coal. This coal-field has long been known to foreigners through the Chinese as a possible source of workable coal. As long ago as 1863 Prof. Pumpelly suggested that the Liantung coals should be examined by American or European experts before opening the mines at Chaitang, which he had personally visited and reported upon favourably.

“So far as I know, no geologist has visited the district except Baron v. Richthofen, who regarded the formation as of Palæozoic age, although, I believe, he found no fossils.

“From my own observations while travelling through the provinces of Chih-te and Shansi, and from various sources of information, I believe by far the greater part of the coal-basins of North China are of Palæozoic age, although the well-known districts west and north-west of Peking have been shown to be of Mesozoic age.

“The estimates of the great area and value of the coal and iron deposits of North China, which have been made by Prof. Pumpelly and Baron Richthofen, are, I think, by no means unwarranted.

“There can be no question but that the coal and iron of China will prove to be of immense value in the material development of the country so soon as she decides to adopt railways and foreign engineering methods.”

On unpacking the collection I discovered that the plants were of Carboniferous age, and that most of them belonged to species common in the rocks of Europe and North America.

Of the ten species which can be distinguished, one is a *Pecopteris* too imperfect for determination (probably *P. unita*, Brgt.), and two others, a *Lonchopteris* and an *Archæopteris*, present slight differences from their closely-allied representatives in Europe and America. The other seven are undistinguishable from what may be considered as the most characteristic plants of our Coal-measures.

The complete list of species is as follows:—

- Annularia longifolia*, Brgt.
- Sphenophyllum oblongifolium*, Germar.
- Calamites Suckowii*, Brgt.
- Cordaites borassifolius*, Ung.
- Lepidodendron obovatum*, Sternb.

Sigillaria Brardii, Brgt.

Pecopteris cyathea, Brgt.

Pecopteris unita?, Brgt.

Archæopteris, n. sp.?

Lonchopteris, n. sp.?

The *Archæopteris* indicates that the coal with which these plants are associated belongs near the base of the Coal-measures, as this genus does not rise above that horizon.

The species of *Lonchopteris* and *Archæopteris* are best represented in the collection; and the former is very well shown. In general aspect it is not unlike the figures given by Brongniart of his *L. rugosa* (Vég. Foss. p. 368, tab. 131. figs. 1, 2, 3); but the pinnules are smaller, and the reticulation much more open. In the latter respect it is more like *L. Baurii*, Andr., *L. Eschweilerianus*, Andr., and *L. conjugata*, Gœpp., sp. (*Neuropteris conjugata*, Gœpp.); but it has narrower, more pointed and curved pinnules than either.

Should a larger number of specimens show that these are constant characters, it will be necessary to regard this as a new species, which may be fittingly named after Mr. Hague, *Lonchopteris Hagueana*. The *Archæopteris* mentioned is a very graceful and well-marked species of the genus, having obovate or spatulate pinnules, of which the upper extremities are often crenulate or fimbriate. It is less robust than the type forms of *A. hibernica*, Forbes, sp.; and the pinnules are more symmetrical. It is about the size of *A. Jacksoni*, Dwn., but has less crowded, more elongate, and more regularly ovate or spatulate pinnules. The nerves are fine, forked only near the base, simple and subparallel above. Possibly this may be, like several described species of *Archæopteris*, only a variety of *A. hibernica*; but the characters mentioned seem to separate it from any known form, and I would suggest for it the name *Archæopteris spatulata*.

The first fossil plants brought from China were collected by Prof. Pumpelly, and were described by the writer in the 'Smithsonian Contributions' of 1866. These included two new ferns, *Sphenopteris orientalis*, N., and *Hymenophyllites tenellus*, N., *Pecopteris whitbyensis*, found in the Lias and Upper Trias of Europe, *Podozamites lanceolatus*, a Liassic plant of the old world, and *P. Emmonsii*, which occurs in North Carolina, all of which seem to represent the Upper Trias or Lower Lias*. Subsequently (in 1868) M. Ad. Brongniart ex-

* My paper on the fossil plants collected by Prof. Pumpelly has been reviewed by Heer ('Jurafloora Ostsibiriens,' p. 17) and Schenk (Richt-hofen's 'China,' vol. iv. p. 264), with some suggestions in regard to their generic and specific relations, which would hardly have been made

amined a collection of plants obtained from Southern Shansi, and gave a list of them in the Bull. de la Soc. Géol. de France, 3rd series, vol. ii. p. 408. They included some of the species collected by Pungpelly, and were considered by M. Brongniart to represent the Upper Trias and Lower Jura. More recently Baron v. Richthofen obtained fossil plants from various parts of China; and these have been described by A. Schenk in vol. iv. of Richthofen's 'China.' They represent two distinct horizons—one Carboniferous, and the other Mesozoic. The former were found in the districts of Shansi and Hunan. Here were obtained *Pecopteris cyathea*, *P. unita*, *Annularia longifolia*, Brgt., *A. maxima*, Schenk, *Sphenophyllum emarginatum*, Brgt., *S. Schlotheimii*, Brgt., *Calamites gigas*, Brgt., &c. Elsewhere in the provinces of Shansi and Tshili, Richthofen obtained a group of Mesozoic plants, among which M. Schenk recognized *Pecopteris whitbyensis*, *Podozamites lanceolatus*, and other species which led him to refer the strata containing them to the Brown Jura.

It is known to most geologists that the extensive coal-basins of India, from which fossil plants have been described by Oldham and Morris and Dr. Feistmantel, are all of Mesozoic age. The same is true of the coals of Tonking, Cochin China, from which a considerable number of fossil plants have been obtained by the French expeditions and described by M. R. Zeiler in the 'Annales des Mines,' October 1882.

It would seem proven, therefore, that the coal-basins of China (in which the coal is very largely converted into anthracite by local metamorphism) belong to two great geological systems—one, as indicated by the plants collected by Baron Richthofen and Mr. Hague, the equivalent of the Coal-meas-

had these distinguished palæontologists had access to the specimens on which I based my conclusions. Having reexamined these fossils, I take occasion to offer here a few additional notes upon them.

Sphenopteris orientalis certainly belongs to the same genus with the ferns now called *Thyrsopteris Murrayana* and *Th. Mauikana*, Heer, the latter being specifically hardly different from it. *Hymenophyllites tenellus*, N., has finely dissected pinnules, and is certainly distinct. My *Podozamites lanceolatus* is that plant, and not a *Phanacopsis*, as suggested by Heer. This is shown by its nervation, and by the fact that the pinnules are pinnately set on a rachis, and are not fasciculate as in *Phanacopsis*. *Taxites spatulatus*, N., is the leaf of a conifer, and not of a cycad, as inferred by Heer. It has but a single nerve, the median, which is strong and traverses its entire length, and has a wedge-shaped base terminating in a short twisted petiole. The publication of Heer's important paper on the Jura flora of Eastern Siberia has given significance to certain specimens in Pungpelly's collection, and has enabled me to add to the list of species *Baiera angustiloba*, Heer (very near to *B. Munsteriana*), *Phanacopsis longifolia*, Heer, and *Czekanowskia rigida*, Heer.

tures (and probably the entire range of the Coal-measures of Europe and America); the latter not yet capable of so definite classification, but probably referable to both the Rhætic and Lias.

The fossil plants brought by Mr. Hague from China, representing as they do not only the characteristic genera of the Coal-measures in Europe and America, but identical or closely allied *species*, cannot fail to interest both geologists and botanists:—the first, by the confirmation they afford of the classification adopted for the stratified rocks, based on the fossils they contain; the latter, from the evidence they furnish of the practical identity of the acrogenous flora of the Coal period over so large a portion of the earth's surface, and the remarkable persistence which specific characters exhibit in the wide range of migration and the incalculable lapse of time through which the dispersion was effected.

Since none of the higher plants were in existence upon the earth's surface during the Carboniferous age, wherever a terrestrial flora prevailed it could only be composed of acrogens and gymnosperms; but how it happens that within these limits there was so little diversity is incomprehensible. During the Coal-measure epoch the same genera, and to a large degree the same species, seem to have lived in North America, Europe, Brazil, and China.

No one who has any acquaintance with fossil plants would fail to recognize at once most of the species in the collection brought by Mr. Hague; but if shown seven out of the ten he could not say whether they came from America, Europe, or Asia. And yet in the interval between the deposition of the Coal-measures and the Triassic rocks the whole flora of the globe was revolutionized. Before the Bunter was laid down *Lepidodendron*, *Sigillaria*, *Annularia*, *Sphenophyllum*, *Cordaites*, and indeed all the characteristic forms of the coal flora had disappeared. The Cycads in great variety, true Equiseta, and peculiar genera of Conifers and Ferns gave new aspects to nature, and this again over the whole world. From the desert of Atacama, from Sonora, New Mexico, North Carolina, Europe, India, and China we obtain the remains of the unmistakable Mesozoic flora with species which are common to all these widely separated localities.

Hence we are safe in fixing by fossil plants the geological horizon of the Mesozoic coal-basins of China; but the identity of species in the Mesozoic flora, though surprising, is not quite so marked as in that of the Carboniferous age.

In the Middle Cretaceous came another great revolution, and the angiosperms succeeded the gymnosperms so rapidly

that the earth was covered with oaks, magnolias, willows, &c. before the Tertiary began. Gradually we are gathering the details of this wonderful history, and ultimately we shall be able to report the *facts* with a good degree of fulness; but the causes which inspired the revolutions that have taken place in plant life, and the processes by which these great changes have been effected, seem to be as inscrutable as ever.

XXIV.—*On the Structure and Affinities of the Genus Tristychius, Agass.* By THOMAS STOCK, Natural-History Department, Museum of Science and Art, Edinburgh *.

[Plate VII.]

Tristychius fimbriatus, Stock. (Pl. VII. figs. 1 and 1 a.)

This spine I owe to the kindness of those promising young naturalists Messrs. Kinnear and Anderson, who discovered it in the Carboniferous Limestone series at Gilmerton, near Edinburgh. It appears to be hitherto undescribed.

Description.—It is distinctly sigmoidal in shape; but the curvature presents an exaggerated appearance through fracture. The restoration (Pl. VII. fig. 1 a) gives a more correct idea of its original shape. The direction of the curve in the distal region is peculiar, and, indeed, almost without a parallel in Selachian acanthoid remains. Nevertheless I attach very slight importance to it as a systematic character. It is possibly due to disease, of which there is some evidence in certain pustular appearances seen near the pointed extremity of the spine (Pl. VII. fig. 1). It is $1\frac{2}{3}$ inch in length, and $1\frac{1}{2}$ line in greatest width. Its surface is smooth; but a shallow and wide groove occupies a nearly central position along the middle third of the spine. It is difficult to say how far such grooves, which occur rather frequently in the spines of various genera and species, are normal, or whether they arise from the falling-in of the walls of the spine as the soft internal part decays. In the case of *Pleuracanthus*, in which this middle groove is often visible, the appearance is due to decay in all the cases that have come under my notice. But in the example under consideration I am inclined to think that the appearance is normal, as the walls are apparently thick and the

* Communicated by the Author, having been read to the Edinburgh Geological Society, March 15, 1883.